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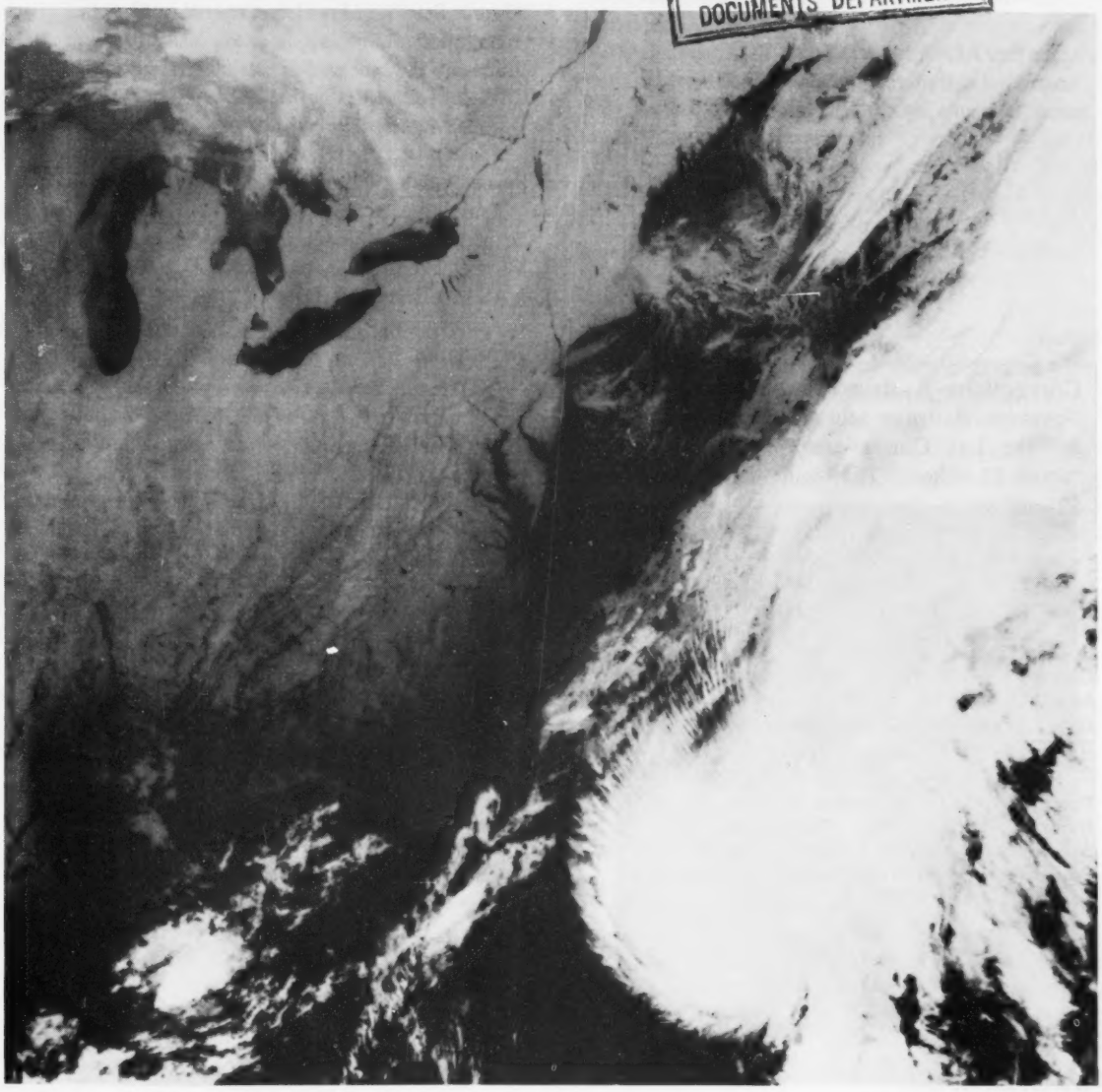

Cover

Newest of the Weather Watchers Goes to Work— This picture of hurricane Kendra, which was thought to pose a threat to the U.S. east coast in early November, was taken by polar orbiting Tiros–N, a third-generation weather satellite. Tiros–N was launched by NASA in mid-October. The hurricane was located off the South Carolina-Georgia coast when photo was made and transmitted early on the morning of Oct. 30 to the Goddard Space Flight Center. Prints were ready that same afternoon. The Great Lakes are clearly visible at top left of photo.

Correction—A statement on page 17 of the November *Activities* said that the annual payroll for the Las Cruces area/Western Union/was "about $2 billion." That figure should have been $2 *million.*

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Letter from Washington

Dear Colleagues:

On Christmas Eve, 10 years ago this month from lunar orbit, the crew of Apollo 8 read back to all the peoples of our Earth the opening words of the Book of Genesis:

> "In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of the deep. And the spirit of God moved upon the face of the water. And God said, let there be light; and there was light. . . ."

That biblical message of a creation that concerns every man, woman and child on Earth came to us from the voices of the first human beings to journey to the Moon—those who first entered the gravitational field of another celestial body and saw the side of the Moon that until then was hidden from earthly view—and it was one of the most powerful forces for unity ever conceived on our planet.

Nothing is more encompassing for all humanity than common understanding of the universe in which we are, an understanding that goes beyond national boundaries and differences among people. Our common knowledge is a piece of common culture and this is an important cohesive force. We all look up at the same sky.

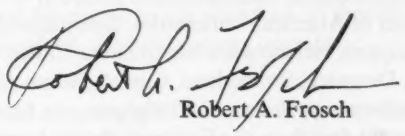
This month Israel and Egypt are trying to make detailed agreements for peace; their leaders will jointly accept the Nobel Prize for peace.

During the Camp David summit in October, a Cal Tech astronomer working under a NASA grant, discovered a previously unknown planetoid swinging in an eliptical orbit between Earth and Mercury. She named it Ra Shalom, the first word for the Egyptian sun god and the second the Hebrew word for peace. Once more a celestial object becomes the symbol for a unity people are trying to achieve.

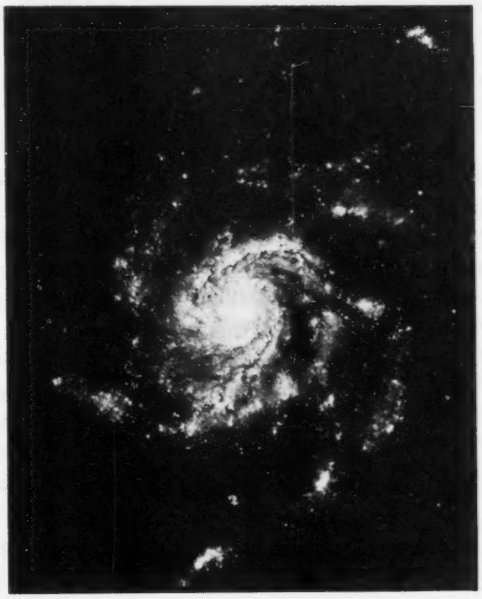
Few events can match the drama of the Christmas Eve reading from the Moon. But the Earth-based scientific investigation of that part of creation which lies beyond our Earth, and the search for new knowledge and a deeper understanding of the universe represent forces for peace on Earth beyond our understanding.

At this season of the year we at NASA can take comfort from the knowledge that, in this important way, we are contributing to the vital cause of "peace on earth, goodwill toward men."

Sincerely,



Robert A. Frosch



NASA Launches First Global Atmosphere Pollution Monitor

Nimbus 7, the first satellite designed to monitor the Earth's atmosphere for manmade and natural pollutants was launched Oct. 23 from the Western Test Range at Vandenberg Air Force Base, Calif. It is the last in a series of seven Nimbus environmental research spacecraft launched by NASA since August 1964.

The 907-kilogram observatory was lofted into a 955-kilometer high near-polar orbit. It encircles the Earth every 104 minutes, or almost 14 times a day.

For the first time, Nimbus 7 will provide continuous environmental data to help scientists worldwide to determine the physical characterization of the global atmosphere, the oceans, the dynamic atmosphere-ocean interface and the Earth's heat balance—information vital to man's understanding of climate, oceanography, atmospheric pollution and regional and global weather patterns.

Working with NASA scientists on the Nimbus 7 project are scientists from the U.S. National Oceanic and Atmospheric Administration (NOAA) and a number of American universities. International participants include scientists from the United Kingdom, Denmark, Switzerland, Canada, South Africa, West Germany, France and Belgium.

For the first time, the European Space Agency will be bringing on line a direct Nimbus 7 reception and data processing capability at Lannion, France, where it will eventually receive, process and distribute Nimbus 7 data to approved European investigators on a regular basis.

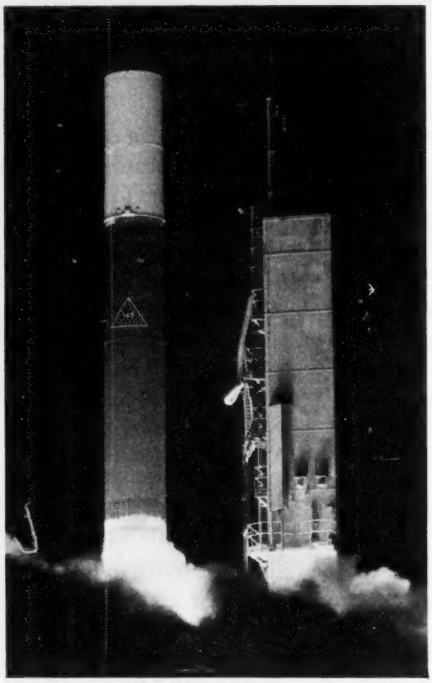
The eight highly complex sensors on Nimbus 7 —seven from the U.S. and one from Great Britain— are improved versions of one or more instruments flown on six previous Nimbus flights and hold promise of providing scientists with insight into the answers to three questions of importance to mankind: Is the ozone in the Earth's upper atmosphere changing? Is the Earth warming up or cooling down? What is the extent of pollution in the world's oceans?

The Nimbus program is directed by NASA's Office of Space and Terrestrial Applications at headquarters. The Goddard Space Flight Center is responsible for management of the spacecraft, the Delta launch vehicle and the global network for tracking and two-way communications with the spacecraft. Launch of the Delta was supervised by NASA's Kennedy Space Center unmanned launch operations team.

General Electric Co., Space Division, Valley Forge, Pa., is the Nimbus prime contractor. McDonnell Douglas Astronautics Co., Huntington Beach, Calif., is prime contractor for the Delta launch vehicle.

More than 50 major subsystem contractors are responsible for the sensors and various components in the spacecraft, launch vehicle and ground receiving equipment. In addition, more than 1,000 subcontractors and vendors are working on the program.

The Nimbus 7 spacecraft and instruments cost $79-million, $2.6 million less than was budgeted. The Delta launch vehicle cost about $4.6 million.



NASA Aircraft Test Engines May Reduce Noise, Pollution

New potential for major reductions in noise and air pollution is expected on the basis of two experimental aircraft engines under test by the Lewis Research Center and the General Electric Co. at Peebles, Ohio. Technology from both engines is directed toward future short-haul, commuter-style aircraft of the 450-to 800-kilometer range, which customarily use small, not major, airports.

The research engines are known as quiet, clean, short-haul experimental engines (QCSEE), pronounced "quick-see." NASA believes that much of the QCSEE technology can also be applied to engines in the 80,700-newton thrust size which power the largest planes in the nation's commercial passenger fleet.

Test results show that the two 40,300–N thrust powerplants run 8 to 12 decibels more quietly than the quietest—the CF6 engine—now in use on wide-bodied DC–10 and 747 civil transports. That would place them about 16 db below current FAA noise level standards and some 9 db below the tougher FAA requirements that will take effect in the 1980s. A 20-db noise reduction would represent the noise level difference between a busy freeway and a quiet residential street.

FAA aircraft noise measurements are made at prescribed points under and alongside the aircraft flight path during takeoff and approach. Noise measurements, expressed in units are adjusted for the human ear's sensitivity to certain frequencies and tones and also for the duration of the sound. Another way of indicating the noise produced by an aircraft is the size of its "footprint" area. This is the ground area directly below the aircraft which is subject to a given noise level during takeoff and landing.

A four-engine aircraft using the technology from one variety of the two research engines would have a footprint of only 3.4 square kilometers in contrast with a DC–10 footprint of six times that area, and with one 40 times that area—the first U.S. commercial jet ever flown, the Boeing 707. The other engine would have an even smaller footprint of 3.1 sq. km.

Noise levels have been much reduced according to Lewis center engineers, by slowing the velocity of the engine exhaust. Technically, this was achieved by increasing the ratio of air passing through the engine fan to air passing through the core of the engine and by other design features including the use of acoustically absorbent materials.

Aeronautical engineers on the project also are reporting substantial air pollution reductions for the research engines compared with engines now flying. Carbon monoxide emissions, for example, would be reduced 84 percent through use of the one engine and 81 percent with the other. Unburned hydrocarbons would be reduced 98 percent for one engine and 97 percent for the other. These two emissions are two of the most troublesome air contaminants from the aircraft discharges.

Lewis engineers said that the air pollution improvements are traceable to new design principles incorporated in the engine combustion system and that these lower emission levels would more than meet stringent Environmental Protection Agency standards set for next year.

A third bonus of the new short-haul experimental engines would be fuel savings of about 10 percent compared with fuel consumed by similarly sized engines now in use. The improved fuel economy shown has come from substituting lightweight nonmetallic composite materials of equal or greater strength for such normally heavy metal components as the engine cowling, frame and fan blades, engineers said.

Although the two experimental engines differ internally, the most obvious difference between them is the way the engines are mounted on an aircraft wing. One engine is designed for mounting under the wing as in conventional installations. The other, a departure from the norm, is designed for location over the wing. In both positions, jet exhaust is deflected downward by the wing flaps to provide added aircraft lift for short runway operating capability.

An added advantage of the unorthodox over-the-wing configuration is that the wing would partially shield people on the ground from engine noise when the airplane is in flight.

QCSEE is a $30-million program, aimed at developing and demonstrating the technology for two powered lift engine varieties (under the wing and over the wing) to achieve reduced airport congestion, aircraft noise and air pollution around airports. The General Electric Co. is the prime contractor for both engines.

The unorthodox over-the-wing version of QCSEE is now undergoing aerodynamic and acoustical performance testing at Lewis with the engine mounted on a simulated wing. Engine testing of the more conventional under-the-wing (UTW) engine has just been concluded at General Electric's facility in Peebles. The UTW engine will also be tested on a simulated wing at Lewis to determine its aerodynamic and acoustical properties.

The new aircraft engine technology was the subject of the Quiet Powered-Lift Propulsion Conference at the Lewis center held Nov. 14 and 15.

The Bill of Fare in Space

If all goes as expected with the research now in advanced stages at the Johnson Space Center, the crew aboard the Space Shuttle orbiter will not suffer from malnutrition; nor will mealtimes be monotonous —instead they should be a pleasurable interruption of the daily chores.

The dining table aboard the Space Shuttle orbiter may not be set with silver, candles and snowy linens, but it *will* offer tasty nutritious meals served in an attractive manner. Menus will be well balanced (3,000 calories a day), with piping hot entrees, reasonably cold fruit beverages or dessert, and plenty of condiments. Crew members who like to put catsup on everything may do so; those who can't get to sleep without cookies and a drink may choose from a fairly wide selection.

A typical daily menu aboard Shuttle may be: breakfast—orange drink, peaches, scrambled eggs, sausage, sweet roll, cocoa; lunch—cream of mushroom soup, ham and cheese sandwich, stewed tomatoes, banana, cookies and tea; dinner—shrimp cocktail with sauce, beefsteak, broccoli au gratin, strawberries, pudding, cookie, cocoa. Many of the foods—breakfast bars, for instance—come right off supermarket shelves.

All meals will be prepared with variety in mind, so that a space traveler may have a different menu for six successive days. On the seventh day the cycle begins again. Dining can be at a table in the galley from a food tray or from a tray held in the lap or affixed to the wall. (Zero gravity requires special fastenings on trays.) Ordinary eating utensils will be used.

Types of foods planned for the Space Shuttle include:

Thermostabilized—thermal/heat processed foods canned or packaged in laminated pouches, such as cheese spread, tuna, beef with barbecue sauce.

Intermediate moisture—foods preserved by controlling the moisture, such as dried apricots, peaches.

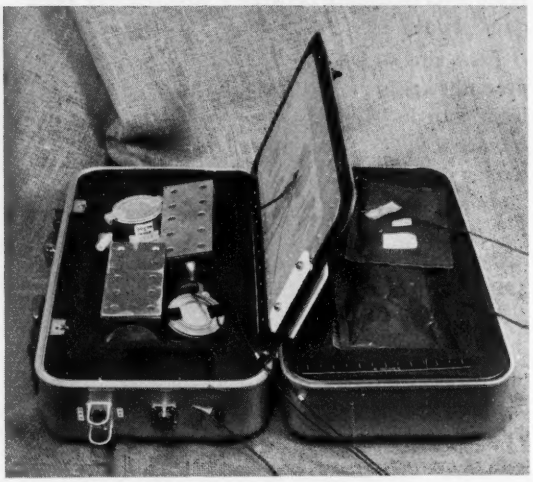
Rehydratable—dehydrated foods reconstituted with water, such as scrambled eggs (do *not* taste like C-rations), beef patty, chicken and noodles; all beverages.

Irradiated—foods exposed to ionizing radiation to improve preservation, such as bread and rolls, or beefsteak.

Freeze-dried—foods with all water removed, to be rehydrated or eaten as is, saliva acting as the moistening agent. Items such as strawberries, shrimp, bananas.

Natural form—foods such as nuts and cookies.

All this is a far cry from the space meals of an earlier era when Mercury and Gemini astronauts had to squeeze various kinds of food into their mouths in a style that might be called *entree a la toothpaste tube;* or when crumbs floating around like motes in a zero-gravity cabin had to be recaptured before they got into the machinery. One of the early astronauts claimed that sometimes it was hard to tell the rations from the container.



Meal in a Suitcase—During orbiter test flights, when many facets of Space Shuttle flight will be tested, this carry-on, plug-in equipment will be used to heat meals in space. Its circuits can heat separate foods to different temperatures with a minimal drain of Shuttle power.

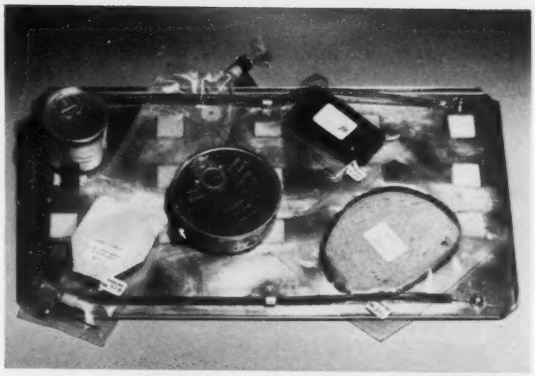
Some of the same people who were doing pioneer work in the preparation of space foods a decade or more ago are still hard at work now at the Johnson Space Center, putting together the much more complex systems to be used on Space Shuttle. Their job is complicated by the fact that a crew of four to seven will have to be supplied with tasty and nutritious food for relatively long periods (seven to 30 days) when the renewal of supplies will not be possible. Another factor they must take into account is the strict weight and volume limitation placed on food and food storage containers.

Understanding the amounts of food a space person needs, then providing the required rations in such a way that he or she actually consumes them in a systematic way are vital, not only for the maintenance of good health and high energy levels but for the conduct of the mission itself. On flights of a year or more into deep space, for example, even a slightly high miscalculation of daily food requirements could mean excessive weight and volume penalties to the spacecraft. An underestimation could be disastrous. But even when all these practicalities are met, the gastronomic factor remains—if rations provided are unattractive aesthetically, stale, too bland or served too often, the physical and mental well-being of the consumer can be adversely affected. As all travelers know, the longer the voyage the more important eating seems to become.

In past years, much of the research and development related to proper nourishment in space was contracted to firms with laboratories and test kitchens outside the Johnson center. Technology, Inc. was associated with the early work and is currently under contract for research and food preparation, as well as the development of new methods tailored to meet Shuttle needs. Now all activities are centered under one roof—in the Office of Space and Life Sciences at JSC. Richard Sauer is the NASA Shuttle food manager and physiologist Rita Rapp (who says she has been with the NASA food development program "forever") work closely with center-based Dr. Charles T. Bourland and several associates from Technology, Inc. They spend a great deal of time in the spacious, ultra-modern test kitchen, testing, re-testing, then testing again, to be sure that a long list of foods remains fresh and tasty under all sorts of circumstances. They test purchased brand-name foods for quality and stability under widely varying storage conditions and they cook, process and package food for the spacepeople. They and co-workers also taste a lot.

The result of the new system has been a significant lowering of costs, coupled with improved systems. As plans stand now, the older tested systems will prevail during the first several orbiter flight tests. When operational flights begin, it is expected that the new procedures will be installed and in good working order.

From the beginning of the national space effort, the down-to-earth topic of food in space has captured the attention of both observers and participants. In the early days, when space flights were short, food was not too important, but it became a more serious consideration, then a vital one, as space travelers began to range farther and stay longer. At first, menus included only the tubes of pastelike food served at room temperature or lukewarm, dehydrated cubes, and a few freeze-dried items. They were consumed without enthusiasm.



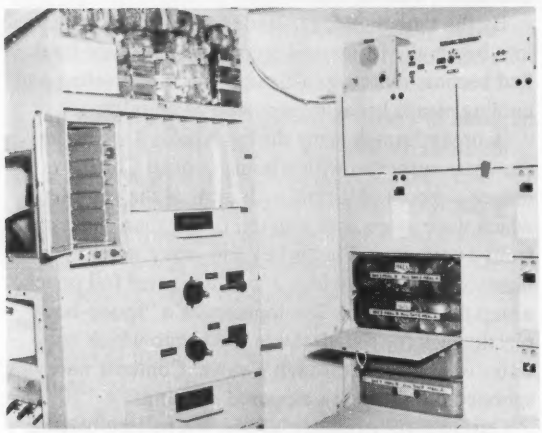
Gravity-resistant Food Tray—This specially devised tray will be used when astronauts eat, because of the zero-gravity ambience. Meal components are affixed to a tape (velcro) and plastic envelopes are held down by springs.

By the time the longer-lasting Apollo flights came into being, the forms and preparation of space food had become more sophisticated, and new heating and cooling means brought improved palatability.

A breakthrough came during Apollo 8 when the crew was surprised with a home-cooked Christmas dinner—pieces of turkey with most of the trimmings, which were eaten with a spoon rather than squeezed from a container. The turkey and gravy were thermostabilized and packaged in a laminated foil pouch, a step that led to the development of a "spoon-bowl" plastic pack for rehydratable foods into which hot water was injected through a valve. Contents were spooned out through a zippered opening.

During early Apollo missions, the pattern became standardized: 2,800 calories a day consisting of 16 to 17 percent protein, 30 to 32 percent fat, and 50 to 54 percent carbohydrate. Food was of two types: dehydrated cubes and lightweight freeze-dehydrated servings. The cubed foods consisted of solids processed in the form of compressed and/or dehydrated cubes which could be rehydrated by the saliva in the mouth as food was chewed. Freeze-dried foods, which retain flavor, nutrition and fresh appearance even after processing, were reconstituted by injection of a specific amount of hot or cold water. All were packed in heavy plastic.

Three Meals a Day for Three Days—This space-saving, compact storage container is designed to hold a maximum of food in minimum space in the Shuttle orbiter middeck galley. As planned, many such receptacles will be stored in the pantry, as well as a large supply of contingency or snack items.



Sky Kitchen—How designers envision the galley to be installed on the orbiter. Stored packages at top left represent four days of contingency rations for four crewmen; oven beneath will hold narrow trays horizontally; water heater is at floor level of storage-oven cabinet; cabinets on right will hold stored packages, utensils, condiments and other items.

Occupants of Skylab fared even better during the 173-day, three mission program. They were given a greater variety of foods at the rate of 1.9 kg per day per man, a volume previously unknown in manned space flight. Freezers, refrigerators and warming trays were used for the first time in space. Except for beverages consumed from a collapsible dispenser, meals were packaged in aluminum cans with the now-familiar pull-out lids. At mealtimes, the astronauts assembled the cans onto a food warmer-retainer tray from which they dined.

American astronauts on the Apollo Soyuz Test Project in 1975 were provided with meals similar to those on Apollo flights. Russian meals were composed of ethnic foods packed in tin cans and aluminum tubes. A small heater was aboard their spacecraft. Menus were prepared according to each cosmonaut's order and generally consisted of meat or meat paste, bread, cheese, soup, dried fruit and nuts, coffee and cake.

The main differences between Space Shuttle food and that served on earlier flights are:

Greater variety and larger amounts. Seventy-four kinds of food and 20 beverages will be available; caloric content has been upped from 2,800 calories on Skylab to 3,000 on Shuttle because tests have shown that working astronauts need the same caloric intake as ground-based people. The generous supply of snack foods can be used as a "swap center" if items in the daily menu are not used; the snacks also can serve as a contingency food supply if necessary.

More efficient handling of food. A real oven will be in operation in the galley. (Perhaps a refrigerator later if space and power supply permit.) Skylab meals, which were heated by conduction, often were not really hot because of technical problems encountered when correct temperatures could not be maintained because of low pressure inside Skylab. The Shuttle oven, operating in a cabin maintained at standard sea-level atmospheric pressure, can heat meals to 85 degrees C and hold levels at 65 degrees C, and it can heat food in containers constructed from different materials and of different sizes and shapes. Rehydratable foods will be reconstituted by water inserted through a narrow tube that perforates the plastic of the container rather than the complex valve used earlier. The new retainer trays will be streamlined, easy to eat from, and will maintain heat efficiency for hot foods while not affecting temperature of cold items.

It should be comparatively easy for a crew member to assemble a meal for four in about five minutes, to be heated and ready to eat in about an hour. Clean-up is simple—"wet wipes," containing a cleaning compound, are used on trays and utensils.

More comfortable, natural dining surroundings. As planned, the comparatively roomy Shuttle galley will have a pantry, an oven, a unit for washing up, hot and cold running water, and a dining table.

Everything won't be perfect, of course. The ice-cream voted the favorite food of Skylab astronauts is not on the menu so far for Space Shuttlers, and no "big Macs" will be served. On the other hand, the crew will not have to eat cold potatoes, the food voted most repulsive by *all* the astronauts.

Booster Recovery System Passes Tests

In a series of test drops completed at the National Parachute Test Range, engineers have demonstrated that when the first Shuttle is launched next year they can have confidence that its solid rocket boosters can indeed be recovered as advertised.

"There will be some additional laboratory tests," said engineer Royce Mitchell of the Marshall Space Flight Center, "but for practical purposes the six drop tests we have performed with the booster's recovery system have given us confidence that the system will do its job." Mitchell is the Marshall center's lead engineer on the booster recovery development project.

In the final test of the series, a booster test article was carried to 6,100 meters and dropped from beneath the wing of a B–52 aircraft operated by NASA's Dryden Flight Research Center. The main parachute was deployed when the test boosters reached 660 kph. Mitchell reported after the mission that the test had gone well, and that the main parachute had withstood forces exceeding those expected during Shuttle operations.

Veteran Ship Ends Space Career

After 12 years of supporting manned space flight missions aboard Apollo, Skylab and Apollo Soyuz spacecraft the USNS *Vanguard,* last of an original five-ship tracking and re-entry coverage flotilla, was transferred on Oct. 1 to the U.S. Navy for navigational and ocean survey work.

Vanguard served NASA astronauts throughout 10 Apollo, four Skylab and one Apollo Soyuz mission as a floating tracking station carrying out assignments in the Atlantic, Indian and Pacific Oceans.

Built by General Dynamics Corp.'s Quincy, Mass. shipyards, *Vanguard* was commissioned Oct. 15, 1966, and became the last of three identical ships (*Mercury-Redstone-Vanguard*) to come off the Quincy ways specifically designed for, and dedicated to, manned space flight. *Vanguard's* three sister ships frequently supported automated scientific satellite missions. The larger ships were capable of supporting all aspects of a manned mission as well as unmanned scientific satellites compared to re-entry ships which were for that purpose only.

The *Vanguard* capabilities were far more extensive. It could function as well an any ground-tracking station, handling voice commands, biomedical data, spacecraft environment reports and command control functions that were transmitted and received through the ship's communications system directly from the Mission Control Center in Houston. The ships were in the tracking network to make certain communication with spacecraft was maintained when they could not be "seen" by tracking stations on land.

Precise distances travelled and hours of mission support have not been calculated, but space tracking and data network veterans estimate that fully half the *Vanguard's* NASA lifetime was devoted to mission support status. The remainder of her time was spent in port, yard repair or transit.

NASA, ESA Sign Agreements for Handling Satellite Data

NASA and the European Space Agency have signed three memoranda of understanding related to the use of data transmitted by the Landsat, Nimbus 7 and Seasat satellites.

The memoranda, signed by NASA Administrator Dr. Robert A. Frosch and ESA Director General Roy Gibson in Paris Oct. 7, concern the acquisition by European ground stations, pre-processing and distribution of data from the Landsat series of satellites, and several ESA-coordinated investigations involving data received in Europe from NASA's Nimbus 7 and Seasat satellites.

The Landsat data will be made available to interested users by Earthnet, a European ground station network set up by ESA. Seasat data is to be used by the Seasat Users Research Group Europe under the auspices of the European Association of Remote Sensing Laboratories.

Nimbus 7 data will be utilized by a further group of European investigators sponsored by the Commission of the European Communities (Common Market).

The Landsat 2 and 3 satellites are in polar orbits at about 805 kilometers altitude; Nimbus 7 is scheduled for launch into a similar orbit Oct. 23. Seasat, launched into polar orbit June 26, ceased transmitting data Oct. 10. Scientists and engineers are trying to determine the cause of its malfunction.

Venus-Bound Craft Pass Critical Tests

The orbiter and the multiprobe, the two Pioneer spacecraft enroute to Venus, have passed major planet operations tests.

Aboard Pioneer Venus 2, the multiprobe spacecraft, tests have been completed on orientation, timing and separation systems for the split-second release of three probes that will spread over the Earth-facing hemisphere of Venus 9,600 kilometers apart.

On Pioneer Venus 1, the orbiter spacecraft, systems for the essential retrofire and injection-into-orbit maneuver (which takes place behind the planet and out of communication with the Earth) have been operated or tested.

The separate operations teams for the two spacecraft at NASA's Ames Research Center have sent 6,400 commands to the orbiter since launch on May 20, and 3,600 commands to the multiprobe craft since its Aug. 8 launch. Twenty days and 13 million km from the planet, the multiprobe splits into the transporter bus and four probes. The bus itself becomes a fifth probe.

The multiprobe now has covered 140 million km on its 325 million km flight path to Venus. The orbiter has covered 325 million km of its longer 500 million km flight path. Both spacecraft still have about 180 million km to travel before reaching Venus. The orbiter arrives Dec. 4, the craft with five entry probes Dec. 9.

The two Pioneers and their 30 experiments are expected to improve understanding of Venus' simple weather machine, and this in turn should help us to better understand the forces that drive Earth's weather.

Virtually all experiments and systems on each of the five entry craft of the multiprobe now have been operated and are working well. These include thermal, orientation, command, communications and data return and power systems—as well as separation systems for the 90-kilogram smaller probes.

This critical separation will allow launch from the spinning transporter bus of three of the entry probes at precise positions in space and within milliseconds of each other, sending them to carefully selected atmospheric entry points on Venus.

The three probes separated from the bus Nov. 19 to enter the atmosphere Dec. 9. They are known as the north, day and night probes. The day probe will enter Venus' southern hemisphere on the day side of the planet, the night probe will enter the night southern hemisphere and the north probe will enter the North Polar Vortex, also on the night side.

Navigation maneuvers enabling the sounder probe to enter Venus' atmosphere near the equator on the day side have been tested, as have those for bus entry in the day side southern hemisphere.

On the orbiter spacecraft, all instruments have been checked and calibrated. Most of the orbiter operations systems have been tested and are in good shape, including systems for insertion of the orbiter Dec. 5.

The six orbiter interplanetary instruments gathered much data during the September-October period of mounting solar activity. On Sept. 23, they measured high solar wind speeds and other phenomena from a major storm on the Sun. The orbiter's "camera" instruments, the cloud photopolarimeter, began measuring light from Venus on Oct. 10. The first pictures of Venus are scheduled for return to Earth on Dec. 5.

The Pioneer is managed for NASA by Ames. The spacecraft are built by Hughes Aircraft Co., El Segundo, Calif.

Nimbus Satellite May Help Chart Great Lakes Pollution

Scientists, and marine biologists who are striving to preserve the largest body of fresh water in the world are receiving large amounts of new and more accurate knowledge about pollution of the Great Lakes. The data come from NASA's Nimbus 7 satellite launched Oct. 23. The satellite carries seven sophisticated sensing devices designed to measure factors ranging from stratospheric aerosols and ozone to polar sea ice extent.

While Nimbus 7 is gathering information on a global basis, scientists from the Lewis Research Center and other regional agencies will be chiefly interested in that portion of it pertaining to Great Lakes regions. Of particular concern will be data from one of the sensing devices, a coastal zone color scanner. The scanning instrument was created to make accurate measurements of water color and temperature, two

characteristics that are affected by the amounts of pollution and algae in the water.

In recent years the Lewis center, in cooperation with the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and other organizations, has been examining and developing ways to measure water quality via sensing from airplanes and satellites.

While the work has shown that many types of water pollution and general water quality can be detected by remote sensors that can measure water color, the results have been limited either because the sensors or the satellite coverage have not been designed specifically to measure water characteristics. The spacecraft that currently measure color were designed primarily for land or meteorological use and in some cases cover an area amounting to one-third of Lake Erie and only repeat such coverage every nine days.

The CZCS, however, has been designed to operate as effectively and efficiently as possible for exclusive use over water. It can take pictures of an area encompassing the entire Great Lakes system in two minutes and will concentrate on any particular area in the Great Lakes four out of every five days.

Data about the Great Lakes will be transmitted from Nimbus 7 to the Goddard Space Flight Center where they will be recorded and processed. Information in the form of photographic products and digital computer tapes will then be stored and disseminated to assigned study groups.

Inner-city High School Experiment for Shuttle

Orbit '81, an unusual educational program sponsored by RCA company involves inner-city high school students in the design and development of a scientific experiment to be placed aboard NASA's Space Shuttle orbiter when it is launched in 1981.

The project results from discussions among representatives of the Camden, N.J. public school system, NASA and RCA. Sponsorship of the program was offered by Irving K. Kessler, RCA group vice president.

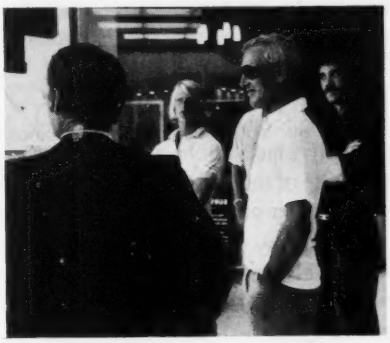
Other high schools are conducting similar programs, but NASA officials said the Camden project is unique because it is the only "total involvement program covering all of the disciplines, arts and skills" that are taught in the curriculum. This means that students taking courses other than science and mathematics will be active participants in the project.

Space has been reserved aboard the Shuttle for the students' experiment, and RCA has made an initial payment to NASA as part of the $10,000 reservation fee. This assures that the Orbit '81 payload, which can weigh up to 90 kilograms and occupy no more than .14 cubic meters, will have a place on board the Shuttle when launch time arrives.

The Camden project qualifies under NASA's "getaway special program" which accepts suitable experiments that will elicit new information contributing to scientific knowledge from any individual or organization from any nation. Typical experiments might be solar studies, chemical phenomena in space environments, or earth resources.

The Orbit '81 experiment to be carried by the Shuttle will be created and built by students of Camden High School and Woodrow Wilson High School. RCA engineers and technicians will assist the students in developing the experiment. In addition, technical assistance and program support have been offered by NASA, FAA, and officials of the New Jersey State Educational Improvement Center.

Orbit '81 will enable students to apply their developing scientific skills in areas that have been frequently addressed by some of the nation's most distinguished scientists and engineers. Selection of the particular Orbit '81 experiment will be made when the students have gained enough scientific insight to participate in the decision. Part of the program involves enrichment courses in space science, summer sessions and tours of NASA and RCA facilities. RCA is donating surplus laboratory equipment to the schools and NASA is providing literature, special programs, lectures and demonstrations. Students at both schools have attended a space colloquium presented by NASA and RCA.



A Star in Moon Country—Actor Paul Newman recently toured NASA's JPL with a group of associates. He is shown in the spacecraft exhibit area looking at a Surveyor lunar lander.

OSO–8 Spacecraft Turned Off

Sensitive satellite instruments designed to study the Sun during the "quiet period" of its 11 year solar cycle (solar minimum) have also become quiet, no longer "talking" to large satellite tracking antennas on Earth.

The scientific instruments aboard Orbiting Solar Observatory–8 were silenced by a planned radio command sent from the Goddard Space Flight Center to NASA's tracking station in Orroral, Australia, on the satellite's 18,072th orbit. A few minutes afterward, a voice from the Australia station confirmed that the satellite's radio transmission had stopped.

The last of the "sunshine" satellites—which started their investigation of our planet's nearest star with the launching of OSO–1 in 1962—had surpassed its designed lifetime of one year by two years. OSO–8 was launched from Cape Canaveral June 21, 1975. All prelaunch mission obectives were far exceeded by the last of the OSO family of satellites. The pointed experiments aboard OSO–8 obtained the most accurate observations yet of the solar chromosphere and transition regions, giving scientists a better understanding of these regions.

"The OSO series of satellites has provided a vast wealth of scientific information on the Sun and other celestial objects," said Dr. Roger Thomas, OSO–8 project scientist from Goddard. "Each of our satellites carried different and more accurate instruments to investigate new aspects of the Sun. The lessons learned from 16 years of OSO sateilites have been instrumental in the development of new experiments for future studies of the sun such as the Solar Maximum Mission next year," Dr. Thomas said.

Four of the eight experiments aboard the 1,064-kilogram satellite were designed to make measurements of the Sun during the quiet (Solar Minimum) period of the Sun. The solar activity is currently increasing substantially and the solar science community is now preparing for studies of the period of maximum solar activity which will be accomplished in part by the launching of the Solar Maximum Mission satellite in October of 1979.

The non-solar high energy astrophysics experiments on OSO–8 have also made significant observations of the celestial sphere. These experiments have now been superseded by the SAS–3, HEAO–1 and HEAO–2.

The OSO–8 Control Center at Goddard will be reconfigured to support the SMM mission. A number of scientists from OSO–8 Program are now getting ready for the SMM launching next year. The OSO–8 project is managed for NASA's Office of Space Science by Goddard. Prime contractor for the spacecraft is the Hughes Aircraft Co., Culver City, Calif.

Over and Out—GSFC mission operations manager Jim Gemmell (seated) and Bob Pickard, original OSO–8 project manager, load last command into the OSO–8 satellite just before its final shudown.

Rare Memento Received at NASA Headquarters

Administrator Robert A. Frosch recently accepted for NASA a document that marks the anniversary of Charles A. Lindberg's solo trans-Atlantic flight. "Lindy" made his historical crossing from New York to Paris in the "Spirit of St. Louis" on May 20, 1927.

The framed Flight Philatelic Document, containing a series of American and French Lindbergh stamps and cancellations tracing the history of the aviator's magnificent achievement, was presented to 25 individuals and organizations in the United States and France. Friends of the Nassau County Museum (Long Island, N.Y.), producer of the tribute, selected the recipients. They include President Jimmy Carter, French President Valery Giscard d'Estaing, Anne Morrow Lindbergh, and museums and agencies linked to aviation.

Each of the documents bears seven American and French Lindbergh stamps with key cancellations. They

consist of the 1953 50th Anniversary of Powered Flight stamp commemorating Lindbergh's take-off to St. Louis, with May 10 San Diego, Calif. postmark; the 1976 50th Anniversary of Commercial Aviation commemorative, marking Lindbergh's take-off to New York, with May 12 St. Louis, Mo. postmark; the 1977 50th Anniversary Solo Trans-Atlantic Flight issue, commemorating the start of Lindbergh's historic flight from Long Island to Paris, France, with May 20 Roosevelt Field, N.Y. postmark; the 1927 Lindbergh stamp, commemorating the culmination of the historic flight, with May 21 Roosevelt Field, N.Y. postmark; the 1927 American Legion French stamp showing the Spirit of St. Louis, also commemorating the flight, with May 21 LeBourget, France postmark; the 1977 French Lindbergh/Nungesser et Coli 50th anniversary flight commemorative (First Day of Issue stamp of France) commemorating the day Lindbergh boarded the U.S.S. *Memphis* for his return to the U.S., with June 4, LeBourget, France postmark; and the 1968 50th anniversary of Air Mail Service Commemorative, marking the day of Lindbergh's return to the U.S., arriving in Washington, D.C. after the flight, with June 10 Washington, D.C. postmark.

The document was autographed by President Carter, President Giscard d'Estaing, Paris Mayor Jacques Chirac, U.S. Postmaster General (1977) Benjamin Bailer, French Postal Secretary Norbert Segard, and Mrs. Lindbergh.

As part of what will become a permanent exhibit, the document will be sent to each NASA center during 1979.

Rare Historic Record—The Lindbergh commemorative document given to NASA and 24 other recipients.

Tribute to Aviation Pioneer—Dr. Frosch received a rare philatelic memorial to Charles A. Lindbergh in informal ceremonies at his office. Presenting the document to Frosch are Ruth and Charles Dobrescu, who supervised the production for the Friends of the Nassau County Museum, N.Y. The Dobrescus chaired the subcommittee in charge of commemoration ceremonies for the Lindbergh 50th anniversary.

Spacelab Crew Takes Part in European Training

Four Americans joined three Europeans at Porz Wahn, West Germany in October to begin a European training session for Spacelab 1, the first joint manned space mission of the U.S. and Europe. In West Germany and in two other European nations, they will attend training sessions with the scientific investigators who are planning the European-sponsored scientific experiments to be abroad the first Spacelab. The courses end in mid-December.

The payload specialists are: Michael L. Lampton, University of California, Berkeley; Byron K. Lichtenberg, Massachusetts Institute of Technology; Ulf Merbold, a West German research scientist; Wubbo Ockels, a Dutch physicist; and Claude Nicollier, a Swiss astronomer. They will have primary responsibility for operating the Spacelab's science instruments during the mission.

Two NASA Mission Specialists, astronauts Owen K. Garriott and Robert A. Parker, plan to attend a major part of the European training sessions.

Chuck Lewis of the Marshall center is in Europe with the payload crew as the NASA training coordinator. Marshall manages Spacelab 1 payload crew training activities as part of its overall management responsibility for the first three Spacelab missions.

Following their European trip, the group will visit U.S. scientific investigators beginning in January 1979.

Second Pioneer Venus Changes Course

Mission controllers have completed a critical maneuver for the Pioneer Venus 2 multiprobe spacecraft. Spacecraft controllers at the Ames Research Center reported that they succeeded in maneuvering the spacecraft into a trajectory that will put it right on target for encounter with Venus on Dec. 9, 1978. Without the course adjustment, Pioneer Venus 2 would have passed by Venus about 14,500 kilometers from the surface.

The course correction entailed a day-long procedure featuring a series of timed rocket thrusts in two directions in space to increase the speed of the spacecraft by 2.25 meters per second. Launched Aug. 8, Pioneer Venus 2 is presently speeding away from Earth at 10,400 kmph. Pioneer Venus 1 will arrive five days before Pioneer Venus 2 and will swing into a lopsided orbit around the planet for at least eight months or one complete rotation of Venus about its axis.

The combined missions of the six Pioneer Venus spacecraft are the first designed primarily to study the atmosphere and weather of another planet on a global scale.

Mars Orbiter 2 Silenced

NASA's Viking Orbiter 2 has been shut down after orbiting the planet Mars 706 times over the past two years. The spacecraft ran out of attitude control gas last July, after which engineers at NASA's Jet Propulsion Laboratory sent commands that shut it down.

A sister spacecraft, Viking Orbiter 1, and both Viking landers continue to function well almost three years after launch.

Several months earlier, Orbiter 2 had developed a leak in one of its attitude-control jets. Engineers managed to slow the leak but were unable to stem it completely and the spacecraft lost its last few millipounds of gas by venting its tanks in space.

Viking 2 was launched Sept. 9, 1975. After traveling more than 643,735,000 kilometers, the spacecraft reached Mars orbit Aug. 7, 1976. Viking Lander 2, riding piggyback on the orbiter, landed in the Utopia Planitia regions of Mars' northern hemisphere Sept. 3, 1976.

Plans now call for the three remaining Viking craft to continue operating through February 1979. The Viking project will go on through September 1979, while scientists and engineers finish processing the backlog of data from the spacecraft and their experiments.

The Viking continuation mission is operated for NASA's Office of Space Science by JPL, a research facility operated for NASA by the California Institute of Technology. NASA's Langley Research Center has primary responsibility for the Viking mission. The orbiters were designed and built at JPL, and Martin Marietta Aerospace of Denver, Colo., designed and built the Viking landers.

The Viking orbiters were designed to operate for 150 days after planetary encounter. To avoid planetary contamination, the spacecraft were designed to orbit Mars for at least 50 years before disintegrating in the atmosphere.

NASA Astronomers Detect Changes in Uranus Atmosphere

Major changes deep in the atmosphere of Uranus have been discovered by two radio astronomers at NASA's Jet Propulsion Laboratory.

Dr. M.J. Klein of JPL's planetary atmospheres research section and Dr. J.A. Turegano, a visiting research associate at JPL from the University of Zaragosa, Spain, found that radio emissions from deep in the Uranian atmosphere have become 30 percent stronger in 10 years. They report their findings in the latest issue of the *Astrophysical Journal Letters*, publication of the American Astronomical Society.

Klein and Turegano, who made their observations with NASA's 64-meter radio antenna at Goldstone, Calif., explain that the radio waves, which penetrate the dense clouds on Uranus, originate deep in the atmosphere where pressures are thought to be more than 10 times greater than at Earth's surface. The observations, made in the spring of 1978, confirm a discovery made by the two astronomers a year earlier. They believe their results can be explained if the atmosphere on Uranus is either warming or becoming clearer to the passage of radio waves. They say it is hard to believe that the temperature so deep in a planet's atmosphere could become 30 percent warmer in only 10 years. A similar change on Earth would raise our average air temperature above 120 degrees Celsius. It is more likely, they explain, that the change is related to the planet's unique orientation. Unlike any other planet, Uranus spins on its side as it orbits the Sun.

Every 84 years (the length of one year on Uranus), the Sun shines directly on the north pole; 42 years later the northern hemisphere is dark and the south pole points sunward. The north pole is now turning toward the Sun after 42 years of darkness. It will point directly at Earth (and the Sun) in 1987.

The radio emissions from the deep interior of Uranus are probably blocked by ammonia gas in the planet's atmosphere. The two scientists suggest that ammonia might be preferentially depleted in the polar regions of the planet—either by convection currents or chemical reactions. If this were the case, then at present the radio telescopes would be measuring hotter temperatures, deeper in the atmosphere, than were measured 10 years ago when the planet's orientation to the Sun was different.

Theoretical studies are now going on to determine how the radio measurements may be related to global changes in the climate, weather patterns and the chemistry of the Uranus atmosphere. Those studies aid in development of general theories about planetary atmospheres, which in turn are applied to specific studies of Earth's atmosphere.

Current studies of the radio temperatures of Uranus are important to an understanding of the origin of the solar system because recent results suggest that Uranus, unlike Jupiter and Saturn, has more than its expected share of heavier-than-helium elements. That conclusion suggests that a chemical imbalance occurred in the outer regions of the solar system billions of years ago when it was forming.

Johnson Receives Pecora Remote Sensing Award

David S. Johnson, director of the National Environmental Satellite Service in the Department of Commerce, has won this year's 1978 William T. Pecora Award for his work in applying satellite remote sensing to the monitoring of weather and the environment. The award has been presented annually since 1974 by the Department of the Interior and NASA to honor outstanding contributions by individuals and organizations in the field of remote sensing.

Johnson, 54, was presented the 1978 award by Robert Herbst, Assistant Secretary of the Interior for Fish and Wildilfe and Parks, at a banquet Oct. 11 in Sioux Falls, S.D., as part of the Fourth Annual William T. Pecora Memorial Symposium on remote sensing.

Pecora, who died in 1972, was Undersecretary of the Interior and earlier was Director of the U.S. Geological Survey. He was a motivating force in the development of NASA's Landsat Earth resources survey satellite program and in the establishment of the Interior Department's EROS (Earth Resources Observation Systems) program managed by the USGS.

The award citation says Johnson "has devoted a major portion of his scientific and managerial life to the development and implementation of remote sensing systems designed to observe weather patterns, impacts of weather and man on our environment, the climatological trends of the Earth, and in the process eliminated or alleviated loss of property and life as a result of natural disasters."

New Deputy Director at Dryden

John W. Boyd was recently named deputy director of the Dryden Flight Research Center. The assignment becomes effective Jan. 1, 1979. Boyd fills the position vacated by Isaac T. Gillam who was named director of the Dryden center this past June.

Boyd has been deputy director of aeronautics and flight system at the Ames Research Center since 1970. He joined the Ames staff in 1947.

Born in Danville, Va., Aug. 19, 1925, Boyd received his B.S. degree in aeronautical engineering from Virginia Polytechnical Institute in 1947. He is a 1955 graduate of Stanford School of Business under a Stanford Sloan Fellowship. Author of many technical reports, Boyd has received several honors for his work, including the NASA Exceptional Service Award.

New Appointment at KSC

Jack H. Williams recently was named director of ground systems in the Technical Support Directorate at the Kennedy Space Center by KSC Director Lee R. Scherer.

Williams formerly served as the associate director for management, Support Operation Directorate, at the center. His promotion followed the reorganization of the center's Technical Support Directorate to provide more effective and efficient response to the developing requirements of Space Shuttle operations.

In his new position, Williams will direct the operation and maintenance of KSC's support systems, equipment and facilities, and the general maintenance of its facilities and utilities. His unit is responsible for the center's water, electrical distribution, heating and air conditioning, environmental control, pneumatic and sewage collection, and treatment systems; retrieval operations for the solid rocket boosters and their parachute refurbishment; management of propellant and gases and of life support systems; and the development and shops support division which handles KSC's technical service shops, provides qualification testing for components and systems, and performs required modifications to facilities and equipment.

Williams joined NASA in February 1961. He worked first in the instrumentation planning branch, and then in the plans, programs and requirements office, which later became the Apollo program office. He spent 10 years as head of the NASA test support office, which coordinated Eastern Test Range support for NASA launches from the Cape Canaveral Air Force Station and KSC.

Chairman Teague Awarded NASA Medal

Rep. Olin E. Teague (D–Texas) was awarded NASA's Distinguished Public Service Medal, Oct. 3, at an outdoor ceremony at NASA headquarters. Teague is Chairman of the House Committee on Science and Technology.

NASA Administrator Robert A. Frosch lauded Teague's efforts in behalf of NASA and the U.S. space program saying: "For us at NASA, Chairman Teague's most outstanding asset has been his consistent and unswerving faith in the value and virtue of a dynamic and imaginative space program—a faith which he has conveyed to all the elements of the government, industry and university team on which all progress in space depends.

"The single episode which best epitomizes Mr. Teague's profound faith in the space effort was the leadership he demonstrated at the time of the Apollo fire in early 1967 . . . Undoubtedly, more than any other single individual, Chairman Teague saved the program and redirected our energies in a direction which resulted in the successful lunar landing within the decade of the '60s."

The citation accompanying Teague's medal award reads:

"In recognition of his distinguished contributions to the scientific and technological advancement of the nation by his steadfast advocacy of a strong national space program. In two decades of leadership positions in the House of Representatives, he gained the continuing support of the Congress for the cause of building and maintaining the spacefaring capabilities of the United States."

Teague is retiring from Congress after his present term, following more than 30 years of service as a member of the House of Representatives.

Guests attending the ceremony included Mrs. Teague; James E. Webb, former administrator of NASA; Rep. Don Fuqua (D.–Fla.), Chairman of the House Subcommittee on Space Science and Applications; and Astronaut Alan B. Shepard, Jr., a Congressional Space Medal of Honor winner.

NASA Booster Lauded—Cong. Olin "Tiger" Teague (left) receiving NASA medal from Dr. Frosch at NASA headquarters. Looking on are Dr. Lovelace (at Frosch's shoulder) and Cong. Don Fuqua.

Ten Companies Chosen for Contracts

Ten companies have been selected to begin contract negotiations for projects to improve current methods of manufacturing modules of photovoltaic cells. Photovoltaic cells, also called solar cells, are crystalline wafers which convert sunlight directly to electricity with no energy-wasting steps in between.

The goal of the $4 million effort, announced by the Department of Energy and NASA's Jet Propulsion Laboratory, is to focus on improved methods of production that will lead to cost reductions in the 1979–81 period. This work supplements current program efforts aimed toward the DoE's 1986 goal of less than 50 cents a watt (1975 dollars), a cost that would make photovoltaic energy economically competitive with conventional power sources.

The 10 firms are: Arco Solar, Inc., Chatsworth, Calif.; Energy Materials Corp., Ayer, Mass.; Kayex Corp., Rochester, N.Y.; Kluicke & Soffa Industries, Inc., Horshan, Pa.; MB Associates, San Ramon, Calif.; Motorola, Inc., Semiconductor Group, Phoenix, Ariz.; RCA Corp., David Sarnoff Research Center, Princeton, N.J.; Sensor Technology, Inc., Chatsworth, Calif.; Siltec Corp., Menlo Park, Calif.; and Sollos Inc., Los Angeles, Calif.

Projects to be undertaken by the firms will focus on better means of mass-producing large modules of silicon-based photovoltaic cells. The 10 winning companies were selected on the basis that the new techniques proposed could be applied widely to industries producing flat (or non-concentrating) photovoltaic modules in the 1979–81 time period.

The projects involve techniques which can be applied to the entire range of production steps, from raw materials to final modules. Examples of work to be done once contracts are signed include novel techniques for slicing the silicon solar cell material and improvements in ways to assemble the photovoltaic modules.

Solar cells produced by methods developed in this project must have a life expectancy longer than 20 years and the capability of converting more than 10 percent of the incident sunlight into electricity.

NASA's JPL manages the project, designated the "Low Cost Solar Array Project," for the DoE. Six of the 10 companies are small businesses and will receive about 50 percent of the funding. The 10 were selected from among 33 proposers.

Langley Employees Assigned to Headquarters

Three Langley Research Center employees have been selected for the 1978–79 Career Development Program at NASA headquarters.

Dr. Earl K. Huckins III, Thomas E. Pinelli, and Fred B. Beck will take part in the program designed to assist NASA field centers by developing potential supervisors and managers at all levels.

Huckins, assigned to the materials and structures division, Office of Aeronautics and Space Technology, is working on the planning and implementation of the large space structures technology program for next year.

Pinelli, assigned to international affairs in the Office of External Relations, is serving as a project officer to help plan and operate cooperative space and scientific programs undertaken by NASA and foreign countries.

Beck, assigned to the environmental observation division, Office of Space Terrestrial Applications, is assisting the manager of the environmental quality program in the development and implementation of a comprehensive NASA water-quality program.

Center Operations Chief Resigns

G. "Buck" Fernandez, formerly Assistant Associate Administrator for Center Operations (systems management) and currently on loan to the President's Reorganization Project (Data Processing), left NASA on Oct. 7, 1978, to join Computer Sciences Corp., Systems Division, as a senior member of the executive staff.

Fernandez came to NASA in September 1975 upon retirement from active duty in the Air Force. During his Air Force career, he held various program management and computer technology management positions.

Fernandez was graduated from the U.S. Military Academy in 1947 and received an M.S. in Astronautics from the Air Force Institute of Technology in 1964. He also received an M.S. in Business Administration from George Washington University in 1969.

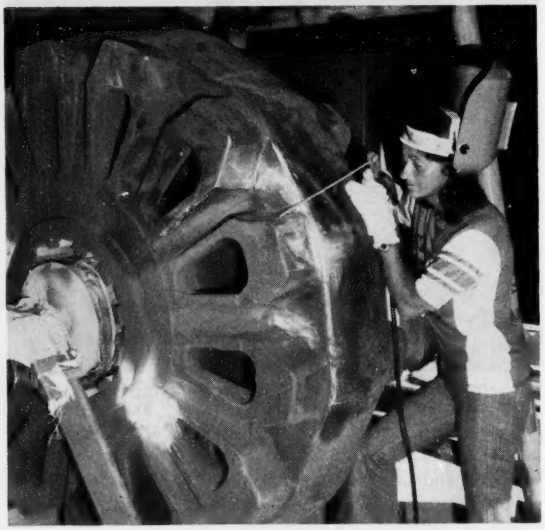
New Chief Scientist at JPL

Dr. Arden L. Albee, professor of geology at the California Institute of Technoolgy recently succeeded Prof. Rochus E. Vogt as chief scientist at the Jet Propulsion Laboratory. Vogt was named chairman of the Caltech physics, mathematics and astronomy division. JPL is a government facility operated for NASA by Caltech.

Dr. Bruce C. Murray, JPL director said that as chief scientist, Albee will hold membership on JPL's executive council and will function as the focal point for scientists who work with members. During the special four-year assignment, Albee will retain his Caltech faculty position, dividing his time between JPL and the campus, where he will continue research and seminar activities in petrology.

The 50-year-old Albee was graduated from Harvard University, receiving his B.A. in 1950, his M.A. in 1951 and his Ph.D. in 1957. Before joining the Caltech faculty in 1959, he was a field geologist with the U.S. Geological Survey in Vermont, Maryland and Colorado.

Albee was chairman of NASA's lunar science review panel from 1972 to 1977 and has served on numerous NASA planning and advisory committees. Currently, he is study leader for the Mars sample return program. He is a councillor of the Minerologic Society of America and holds membership in the Geological Society of America, the American Geophysical Union, the Geochemical Society and the Microbeam Analysis Society.



Space Laborer—This is Janie Cottrell, the Kennedy center's only female welder. Here, Janie prepares to arc weld one of the massive crawler-transporter sprockets used on a crawler-transporter. Her unusual job has won national attention in various publications and on a TV panel show. She works for NASA contractor Boeing Services International.

Lucky Number—Marking the millionth ticket sold this year —to a member of the Steven Girard family of Des Plaines, Ill.—at the KSC visitor's center. The millionth visitor arrived in August this year, the earliest since 1973. Patronage for 1978 is running some 20 percent over last year.

Did You Know?

An honor roll plaque and a Minuteman Flag were presented to NASA by the Honorable Ray Marshall, Secretary of Labor, for achieving an agencywide participation of 75 percent in the 1978 Savings Bonds Campaign. Ray Kline, Associate Administrator for Management Operations, accepted on behalf of NASA employees. This is the fourth consecutive year NASA has received such recognition. Six centers exceeded 75 percent: Kennedy, Langley, Dryden, NSTL, Ames and Johnson.

Visitors to the Langley Research Center were able to fly their signature and a short message into space in commemoration of NASA's 20th anniversary. They signed a logbook which was reduced to a microdot (a piece of film the size of a postage stamp) holding 10,000 signatures. The logbook was open through October. The microdot will be attached to the outside of the Langley-developed long duration exposure facility, one of the first payloads of the Space Shuttle, which will be left in space for six to 12 months. The microdot will be returned to the Langley visitor center when the facility is returned to Earth. People who signed the logbook were able to order a copy of the microdot for $2 as a memento of the anniversary celebration. Orders will be mailed the first part of 1979.

The number of visitors to JSC passed the million mark in September. The last fiscal year when over a million persons came to tour the center was 1972. In 1977, 850,213 came. March was the biggest month this year, with 8,468 visitors on the 12th. The number varies between 800 and 8,000 a day, with an average of 7,000 walking through the grounds on a Sunday in July.

A recent publication entitled "Remote Sensing and the Earth," is the first and only book ever written specifically for high school students about remote sensing techniques and uses. The text is being used for the first time in late 1978 in five Brevard County (Fla.) high schools. Authors are Craig Brosius, a teacher with the Brevard County School Board, and Kennedy Space Center employees Janette Gervin, Ray Corey and Dr. Jim Ragusa. Limited copies of the book are available from: Brevard County School Board, Instrumental Services Div., Project Remote Sensing, 1274 S. Florida Ave., Rockledge Fla., 32955.

"High Altitude Perspective" (NASA SP–427) describes the capabilities of the U–2 research aircraft based at Ames Research Center to measure water levels, to help fight forest fires, to assess flood damage, to provide data for making maps, to scan the ocean for meaningful color variations, to sample the stratosphere, to provide "ground truth" data in support of satellite investigations, and to perform many other tasks. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, for $1.60.

"Liquid Rocket Engine Turbopump Rotating-Shaft Seals" (NASA SP–8121) is a monograph that deals primarily with the experience and knowledge accumulated in development and operational programs to date, and is therefore concerned with the face-contact, circumferential, and labyrinth seals. For sale by the National Technical Information Service, Springfield, Va., 22161, for $8.00.

"Liquid Rocket Engine Axial-Flow Turbopumps" (NASA SP–8125) is a monograph that begins with a section providing brief background on the axial-pump applications and views the pump in terms of the total turbopump assembly. The remaining sections treat the pump design in the order in which a pump designer would proceed. These sections deal with stage hydrodynamic design, pump rotor assembly, pump strator assembly, pump materials for liquid-hydrogen, applications, and safety factors as utilized in state-of-the-art pumps. For sale by the National Technical Information Service, Springfield, Va., 22161, for $7.25.

"Atlas of Mercury" (NASA SP–423), by M. E. Davies, S. E. Dwornik, D. E. Gault, and R. G. Strom, presents Mariner 10 imagery of nine of the 15 cartographic regions of Mercury. Individual sections include a 1:5,000,000 shaded relief map of the region, a computer-generated photomosaic of the region, enlargements of portions of the photomosaics, individual high-resolution pictures, mosaics of small areas, and stereo pairs located within the boundaries of the cartographic region. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, for $6.00.

The Smithsonian's National Air and Space Museum has installed a Braille reading machine in its gallery called "Benefits from Flight." The new device gives blind visitors access to quotations from scientists and philosophers who have speculated about life in the

future. The same information can be seen by other visitors on a TV screen linked with a computer. The device, a digicassette paperless Braille reading machine, stores information on a standard cassette which is displayed in Braille on demand. The electronically encoded messages on the cassette tape are sent to a series of 12 Braille cells on the outside of the machine. The Braille dots are then raised or lowered and by touching the dots, the blind visitor can read the material stored on the tape. The paperless Braille reading machine is the newest of the many features installed in the museum to serve the handicapped. On the premises are special programs for the physically handicapped and the deaf, and regular tours are available to groups of handicapped visitors. The museum encourages the handicapped to join its regularly scheduled tours as well.

International Aid via Satellite—NASA Administrator Dr. Robert Frosch was presented with the United Nations Peace Medal by U.N. Under-Secretary General Bohdan Lewandowski, Department of Conference Services. Frosch also received a letter of appreciation from Secretary-General Kurt Waldheim in recognition of NASA's assistance during the recently concluded conference on Technical Cooperation among Developing Countries, held in Buenos Aires, Argentina. During the conference, NASA extended the use of a satellite to the United Nations for communications between headquarters in New York and the site of the conference.

Contractor News

Three companies—**Acurex, Inc.** of Mountain View, Calif; **Boeing Engineering & Construction Co.** of Seattle, Wash.; and **General Electric Space Division** of Valley Forge, Pa.—have been awarded study contracts for development of a solar energy concentrator for generating electrical power. NASA's Jet Propulsion Laboratory, acting for the U.S. Department of Energy (DoE) made the awards. Each contract is valued at about $240,000. As many as six of the concentrators will be tested and evaluated at JPL's solar thermal test site at Edwards, Calif. A point-focusing solar concentrator directs mirror-reflected sunlight to a point at which a heat absorber and a heat-driven engine are located. The engine turns a generator to produce electricity. Using this concept, solar energy can provide supplementary electrical power for small communities and rural areas. The solar concentrator to be developed under the new contracts includes the optics (mirrors) and the mechanism that allows the concentrator to track the Sun. Heat absorbers and engine generators are being developed under separate contracts.

The Johnson center has amended the Shuttle orbiter contract with **Rockwell International Corp.** of Downey, Calif. to cover orbiter engineering and provisioning changes. The $1.5 million supplements brings the total of the cost-plus-award-fee Rockwell contract to approximately $3.2 billion.

The Control Data Corp., Minneapolis, Minn., has been awarded a NASA contract for the maintenance of the Langley center computer complex. The complex consists of computer systems and auxillary devices that provide scientific data processing in support of the center's research programs. It is operated on an open-shop basis for scientific, engineering, and other technical personnel performing analytical studies, experimental data reduction, and real-time simulations. All segments of the Langley research community use the vital computer complex capabilities. The basic two-year contract is valued at approximately $4.3 million. It contains three one-year priced option periods, bringing the contract up to approximately $11.5 million.

General Electric Co. Space Division has won an $11 million contract from the Johnson center covering operation of Shuttle orbiter acceptance checkout equipment. The cost-plus-fixed-fee contract

covers ACE test support at Rockwell International's orbiter assembly plant in Palmdale, Calif. and in JSC's Shuttle avionics intergration laboratory including systems engineering, solfware development, equipment maintenance, reliability and quality, and training.

The Douglas Aircraft Company, McDonnell Corp. of Long Beach, Calif., has been awarded a $1 million modification to its NASA contract involving engineering investigations, analyses, design of laminar-flow control subsonic commercial transports for the early 1990s. This modification will permit more complete exploration of promising design alternatives and will allow structural concepts to be more fully evaluated. This effort should be completed by late 1979. The contract is managed by the Langley center.

The Mercury Co., of Tustin, Calif. has been selected for negotiation leading to the award of a NASA contract to implement a pressure systems management program at NASA's Langley center. This program will provide for the engineering evaluation of ground based pressure systems to continue the assurance of a safe working environment and to potentially extend the operating capabilities of unique, high-energy, research facilities at the center. The estimated value of the basic two-year contract is about $1.15 million. The one-year priced option is valued at $637,000. The contract also has two one-year unpriced options.

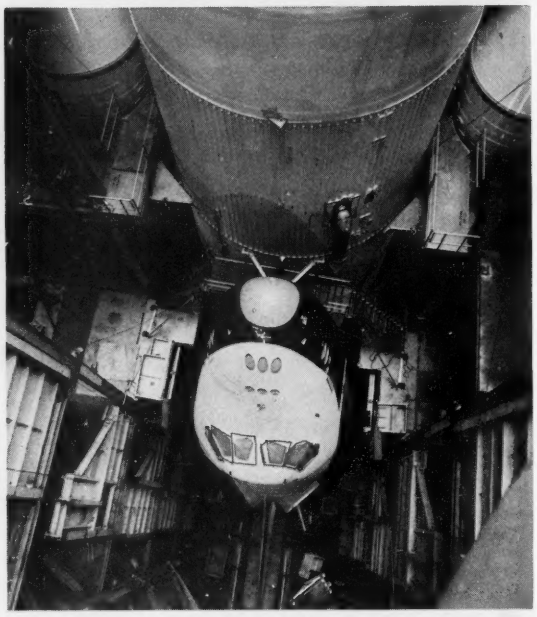
Teledyne Industries Inc. of Northridge, Calif., has been awarded a $2.2 million contract by the Lewis center, for management, engineering and repair services for Centaur digital computer units and remote multiplexer units. The cost-plus-award-fee contract will run for one year beginning approximately November 1, 1978. Work will be performed by the contractor in Northridge and at Kennedy center. The Lewis center provides management of the Atlas/Centaur through all phases of manufacturing, testing and launch.

The Caspan Corp., a Houston minority firm several months ago delivered a scale model of the orbiter neutral buoyancy trainer to the Johnson center. Making the presentation to Dr. Christopher C. Kraft, Jr., and other JSC officials were Frank C. Urteaga, president of Caspan, and Gerald Faz, project engineer. The model represented the final deliverable item required of Caspan under their contract which was awarded through the Small Business Administration's 8(a) Program. All tasks associated with the $241,000 contract were satisfactorily completed on schedule and within the contract's negotiated cost parameters. Other contract tasks previously completed were the engineering design of the buoyancy trainer and the preparation and delivery of complete shop fabrication drawings for a full-scale, high-fidelity representation of the orbiter payload bay and mid-deck of the crew compartment.

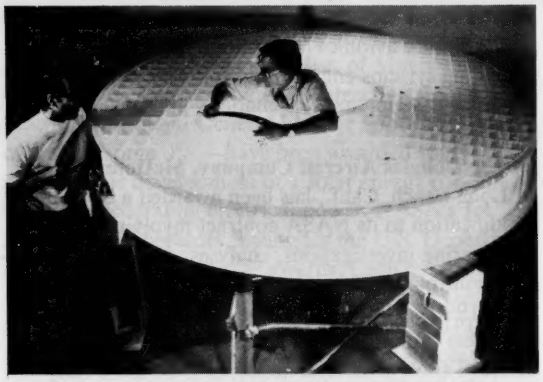
The Riggins Co., Inc. of Hampton, Va., has been chosen for negotiation leading to the award of a $2.9-million NASA contract to provide materials and services for the construction of the National Transonic Facility at the Langley center. The NTF is a unique national laboratory that will help the U.S. maintain its leadership in commercial and military aircraft, including development of technology for future energy-efficient transport planes. The NTF is a new wind tunnel concept that makes possible the use of temperatures as low as 150 degrees below zero C to better simulate the airflow over airplanes at full-scale flight conditions. The work required under the contract includes providing liquid nitrogen, gaseous nitrogen, cooling water, and air and vacuum piping systems.

Walking Through—Honorable John Stetson (left) Secretary of the U.S. Air Force, is escorted by Dr. Robert S. Cooper, director of Goddard center, on a recent tour through the facility's computer and communications complex.

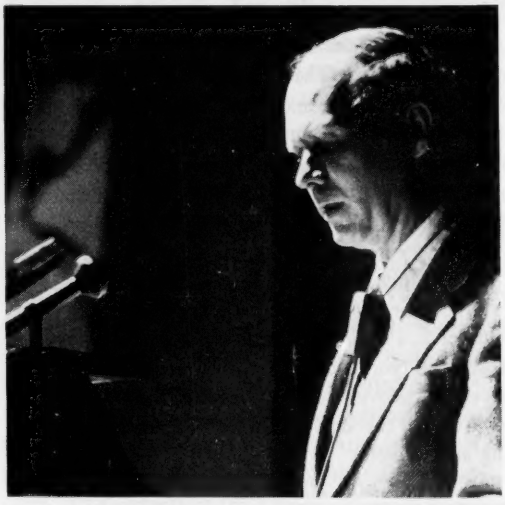
Celebrating Ancestral Ties—KSC Deputy Director Gerald Griffin introduces keynote speaker Dr. Estelle Ramey, world renowned for her work on the effects of hormones, who spoke to center employees about the effects of gender on behavior and achievement at the center's week-long "Heritage Week," held in October.



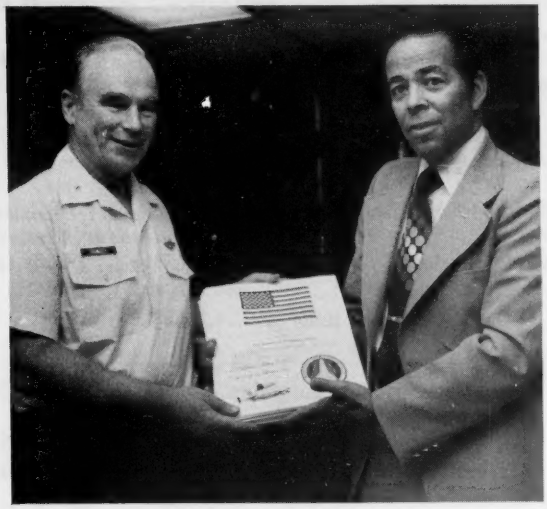
Together at Last—The first complete Space Shuttle is shown shortly after assembly in a 122-meter tall dynamics test stand at the Marshall center. The orbiter *Enterprise*, which participated in the 1977 free-flight tests in California, is joined here with an external tank (holding its propellants) and two solid rocket boosters. Nestled in the test stand, this first complete Shuttle gives a preview of what the real thing will look like when it lifts off from the Kennedy center less than a year from now.



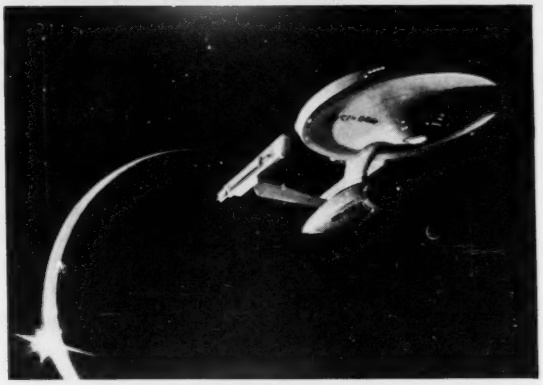
Through a Looking Glass—The huge primary mirror blank for NASA's Space Telescope undergoes inspection by technicians at Corning Glass Works, Canton, N.Y., upon recent completion of manufacture there. The 2.4-meter diameter mirror will become a principal element of the 10-ton unmanned observatory scheduled to be launched into Earth orbit in 1983 abroad the Space Shuttle. The Marshall center has overall management responsibility for the Space Telescope.



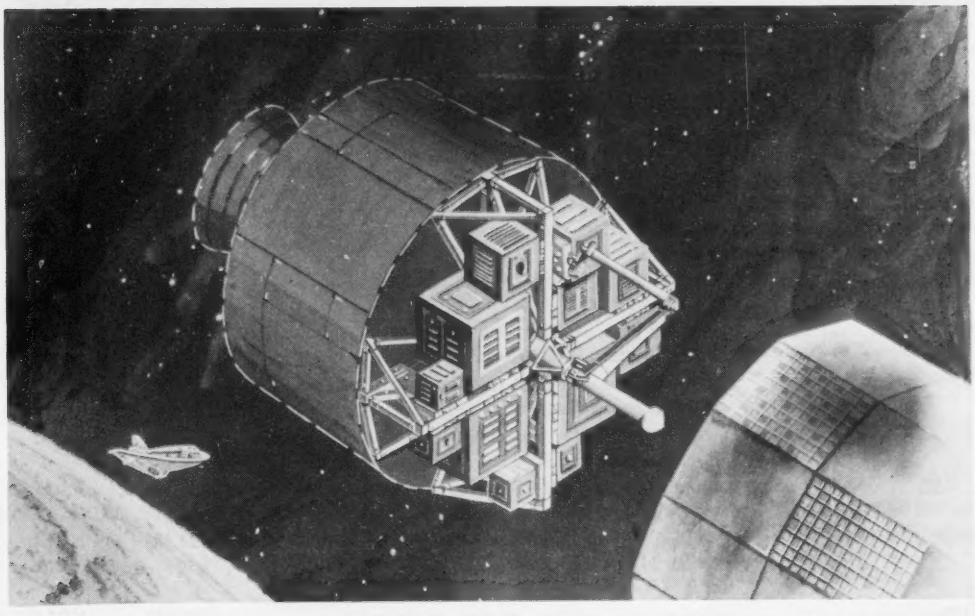
Smylie Discusses Shuttle—Goddard center deputy director Robert E. Smylie addresses an aerospace community audience in Munich, Germany at an International Shuttle User Conference. The conference was sponsored by the American Institute of Aeronautics and Astronautics, the *Deutsche Gesellschaft fur Luft-und Raumfahrt* and the Technical Marketing Society of America. The conference in Germany was in response to a demand from the European aerospace community for a conference similar to the ones held in Washington and Los Angeles last spring. As a result, the special international conference was organized to focus on European needs and interests.



Helping Hand Recognized—Dryden center director Ike Gillam presents Brig. Gen. Phillip J. Conley with approach and landing tests awards for recognition of assistance given during Space Shuttle's ALT program at Dryden.



The New Starship *Enterprise*—A spin-off from the TV series "Star Trek," is the forthcoming motion picture version of the popular show. The new film is now in production, targeted for release next Christmas. NASA's Jesco von Puttkamer (Office of Space Transportation, division of advanced programs) is technical adviser to the film.



Service Station in Space—An artist's concept of a robot-like device that could remove faulty modules from an orbiting spacecraft, replace them with new ones and return the malfunctioning modules to Earth for repair. The unit, known as an orbital servicing system, is under study at the Marshall center. The device was developed for Marshall by the Martin-Marietta Corp., Denver, Colo. The system—deployed in Earth orbit by the Space Shuttle, and transported to higher orbits aboard an orbital transfer vehicle—would be remotely controlled to rendezvous and dock with a disabled spacecraft. Servicing then would be performed by the robotic arm to exchange faulty modules for new ones carried aboard the platform-like servicing system.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

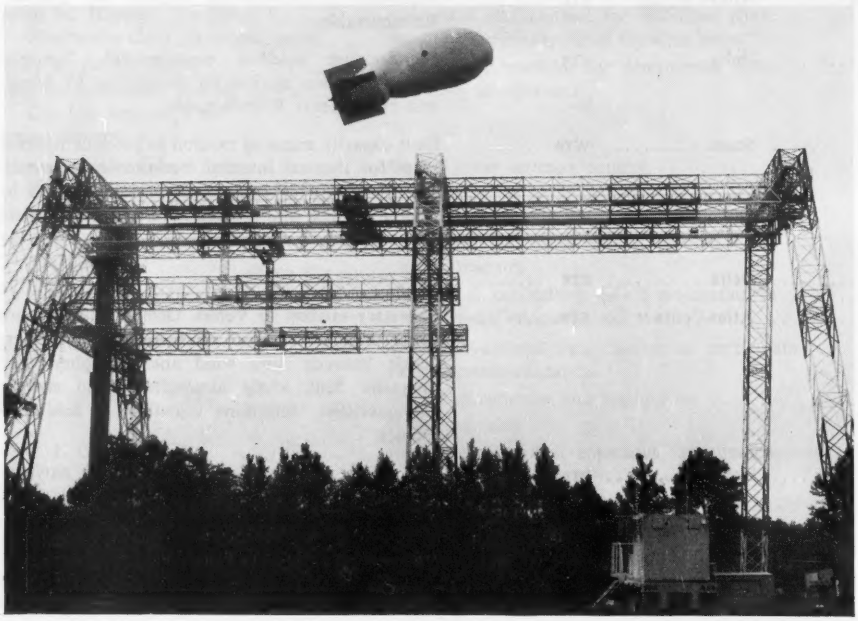
Inventor(s) and Employer	Title	Patent No.	Installation
Jack A. Heller, LeRC	Apparatus and method of reducing thermal stress in a turbine rotor	4,117,669	LeRC
Joseph S. Heyman, LaRC	Pseudo continuous wave instrument	4,117,731	LaRC
Merle A. Economu, DFRC	Wire stripper	4,117,749	DFRC
Thomas E. Williams, GSFC Thomas A. Cygnarowicz	System and method of freezing biological tissue	4,117,881	GSFC
Albert C. Knoell, JPL Abraham H. Wilson	Vehicular impact absorption system	4,118,014	NRLO
Alan S. Fraser Arthur F. Wells Harold J. Tenoso — Organo Diagnostics, El Monte, Calif	Water system virus detection	4,118,315	JSC
William A. Wall, Jr. Robert E. Ives — MSFC M. Melvin Bruce, Jr. Peter Paul Pryor, Jr. — Sci. Systems, Inc. Huntsville, Ala.	Computerized system for translating a torch head	4,118,620	MSFC
Victor S. Reinhardt, GSFC	Time domain phase measuring apparatus	4,118,665	GSFC
Albert J. Bernstein, JPL	Automatic communication signal monitoring system	4,118,666	NRLO
Denis J. Connolly, LeRC	Traveling wave tube circuit	4,118,671	LeRC
Hans Brey, Sperry Rand Corp. Philip E. Geise, Jr., Huntsville, Ala.	FM/CW radar system	4,118,701	MSFC
Phillip M. Hopkins, Lockheed Electronics Corp., Houston, Texas	Apparatus and method for stabilized phase detection for binary signal tracking loops	4,119,926	JSC
Varice F. Henry, GSFC Klaus G. Johannsen, Hughes Aircraft Co., Los Angeles, Calif. Samuel Sabaroff	Systems and methods for determining radio frequency interference	4,119,964	GSFC
George D. Doland, Lockheed, Houston, Texas Electronics Co.	Phased array antenna control	4,119,972	JSC
Murzban D. Jhabvala, GSFC	Complementary dmos-vmos integrated circuit structure	4,121,996	GSFC
Martin H. Leipold, JPL	Method of controlling defect orientation in silicon crystal ribbon growth	4,121,965	NRLO
George C. Hsu, JPL	Surfactant-assisted lique-fraction of particulate carbonaceous substances	4,121,995	NRLO
John C. Evans, Jr., LeRC	Solar cell collector and method for producing same	4,122,214	LeRC
Lester J. Owens, KSC	Illumination control apparatus for compensating solar light	4,122,334	KSC
Oldwig H. Von Roos, JPL	Method and apparatus for measuring minority carrier lifetimes and bulk diffusion length in P–N junction solar cells	4,122,383	NRLO
John E. Ohlson, JPL Macgregor S. Reid	Conical scan tracking system employing a large antenna	4,122,454	NRLO
James D. Johnston Richard H. Tuggle, Jr. John L. Burch Keith H. Clark — MSFC	Apparatus for assembling space structure	4,122,991	MSFC

Jerry C. Poradek, JSC	Simultaneous treatment of SO_2 containing stack gases and waste water	4,123,355	JSC
D. Dixon Collins, Chemical Corp. Bakersfield, Calif.			
Bruce Flagge, LaRC	Septic system liquid level control apparatus	4,123,358	LaRC
David F. Thomas, Jr., LaRC Leon A. Williams, Jr.	Fluid velocity measuring device	4,122,712	LaRC
Robert B. Thompson, Rockwell International Corp., Los Angeles, Calif.	Length mode piezoelectric ultrasonic transducer for inspection of solid-objects	4,122,725	JSC
Dennis J. Fitzgerald, JPL Robert R. Breshears	Plasma igniter for internal combustion engine	4,122,816	NRLO
M. Kudret Selcuk, JPL	Non-tracking solar energy collector system	4,122,833	NRLO

Launches for 1978—Completed and Projected

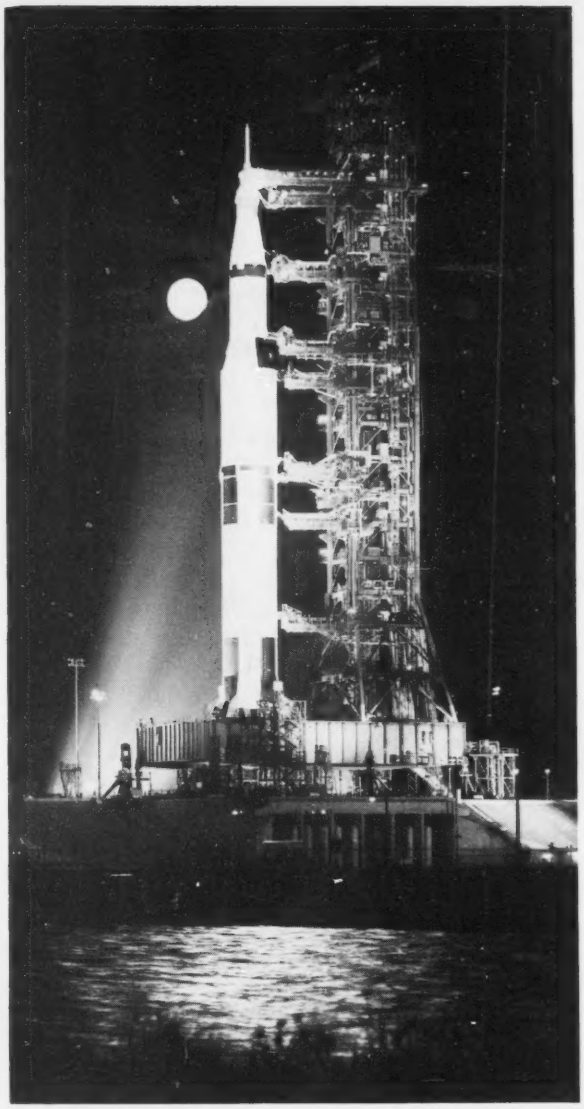
Name	Launch Date	Vehicle	Range	Mission Remarks
Intelsat IVA-(F)	Jan. 6	Atlas-Centaur	ETR	Improved communications satellite for Comsat. Reimbursable.
IUE-A	Jan. 26	Delta	ETR	International Ultraviolet Explorer—cooperative with ESA. Designed to obtain high resolution data on stars and planets in the ultraviolet region of the spectrum.
FLTSATCOM-A	Feb. 9	Atlas-Centaur	ETR	Navy fleet satellite communications. Reimbursable.
Landsat-C	March 5	Delta	WTR	Third Earth resources technology satellite.
Intelsat IVA-F6	March 31	Atlas-Centaur	ETR	Improved communications satellite for Comsat. Reimbursable.
Japan/BSE-A	April 7	Delta	ETR	Broadcasting satellite experimental. Japanese communications satellite for conducting TV broadcast experiments, Reimbursable.
AEM-1 (HCMM)	April 26	Scout	WTR	Heat capacity mapping mission to produce thermal maps for thermal intertial measurements, investigate feasibility of geothermal source location by remote sensing, and provide coverage of snow field for water runoff prediction.
OTS-B	May 11	Delta	ETR	ESA orbital test satellite.
Pioneer Venus-A	May 20	Atlas-Centaur	ETR	Planetary mission to Venus. Orbiter will measure upper atmosphere and ionosphere, study interaction between solar wind and ionosphere and magnetic field, study atmospheric and surface characteristics, determine gravitational field harmonics.
NOAA/GOES	June 16	Delta	ETR	Part of global network of geostationary environmental satellites to provide Earth imaging, monitor the space environment, and relay meterological data to users. Remibursable.
Seasat-A	June 26	Atlas-F	WTR	Sea satellite for global monitoring of ocean geoid, wave topography, surface wind speed and direction, ocean surface temperature, and ice field extent and dynamics.
Comstar-C	June 29	Atlas-Centaur	ETR	Third in a series of domestic communications satellites for Comsat. Reimbursable.

ESA/GEOS-B	July 14	Delta	ETR	ESA spacecraft to conduct scientific, investigation of waves and particles in magnetosphere. Reimbursable.
Pioneer Venus-B	Aug. 8	Atlas-Centaur	ETR	Multiprobe—will determine nature and composition of clouds, composition structure and general circulation pattern of the atmosphere of Venus from the surface to high altitudes, study interaction between planetary environment and interplanetary medium.
ISEE-C	Aug. 12	Delta	ETR	International Sun Earth Explorer. An extension of interplanetary studies with the spacecraft toward the Sun sufficiently outside the Earth's influence for comparison with results of ISEE-A and B missions and of space probes to outer planets.
Tiros–N	Oct. 13	Atlas-Centaur	WTR	Polar orbiting operational spacecraft to provide and improve meteorological data.
Nimbus–7	Oct. 24	Delta	WTR	Develop and flight test advanced sensor and technology basic to conducting experiments in the pollution monitoring, oceanographic and meteorological disciplines.
HEAO-B	Nov. 13	Atlas-Centaur	ETR	Second high energy astronomical observatory to study highly energetic radiation from space.
NATO III-C	Nov. 15	Delta	ETR	Communications satellite, second in series.
Telesat-D	Dec. 14	Delta	ETR	Canadian domestic communications satellite. Reimbursable.



Air Ship Research—A helium- filled balloon used at the Langley center is equipped with various instruments for studies such as atmospheric sampling. Special instruments enabled it to be used in aircraft noise studies in late October. Made of a polyurethane material, the craft measures 12¼ meters long, 4¼ m in diameter and has an area of 99 cubic meters. The balloon may be flown at altitudes up to 914 m.

Lest We Forget—December marks two memorable dates in the history of the U.S. space effort. Apollo 8, the first manned mission to orbit the Moon (20 hours in orbit) was launched Dec. 21, 1968. Apollo 17, the sixth lunar landing and final Apollo mission, took off Dec. 7, 1972, put men on the Moon for 75 hours, and was in lunar orbit for just under 148 hours. Both were launched from the Kennedy Space Center, as thousands of spectators watched.



Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

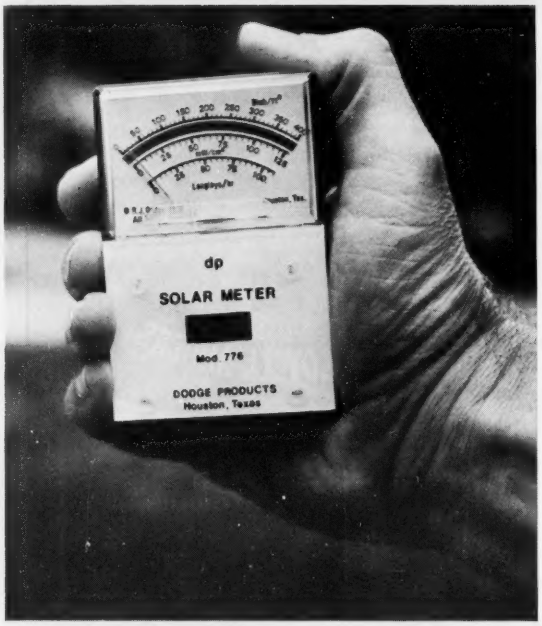
A Way to Measure Solar Energy

An inexpensive solar meter is finding acceptance among architects, engineers, teachers and others engaged in construction of solar energy facilities. It detects the amount of solar energy available at a building site, information necessary to design the most efficient type of solar system for a particular location.

Incorporating technology developed by NASA's Lewis Research Center, the device is based upon the solar cell, which provides power for spacecraft by converting the Sun's energy to electricity. The meter is produced by Dodge Products, Inc., Houston. Texas,* a company formed to bring the technology to the commercial marketplace.

In the Dodge meter, the amount of the sun's radiation reaching the ground is detected by a single solar cell. The information is displayed by a needle pointer which gives a reading in heat or electrical units. A number of readings are taken at different times of day and summed to get total daily radiation. For information as to the energy available over a lengthy period of time, Dodge Products offers a companion device, called an integrator, which makes the measurements and computations automatically. Other related instrumentation is now available from the same company.

In addition to its utility as a solar system design aid, the meter has several other applications. For example. a company that produces glare-reducing film uses the instrument to show customers the difference in solar penetration between ordinary glass and the company's specially film-coated glass. A similar application is measurement of the transmitting qualities of transparent materials. The meter is used to check the performance of concentrators, lenses and mirrors used in solar energy systems.



* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

For the benefit of all . . .

NASA
National Aeronautics and Space Administration

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